

## CLAIMS

1. A recording medium used for storing data, comprising:

a digital stream generated by multiplexing a video  
5 stream and a graphics stream, wherein:

the graphics stream includes a plurality of display  
sets each of which is used for a graphics display;

the display set includes a control segment and  
graphics data, the control segment including time  
10 information that designates an active period of the control  
segment in the display set on a reproduction time axis  
of the video stream; and

when the active period of the control segment in the  
display set overlaps with an active period of a control  
15 segment in an immediately preceding display set, the time  
information designates the active period of the control  
segment in the display set to start at or after a time  
at which, during the active period of the control segment  
in the immediately preceding display set, transfer of  
20 graphics generated by decoding graphics data in the  
immediately preceding display set is completed.

2. The recording medium of Claim 1, wherein:

the active period of the control segment in the display  
25 set is from a decoding start time of the control segment

in the display set to a display start time of the graphics display which is composited based on the control segment in the display set.

5 3. The recording medium of Claim 2, wherein:

the control segment in the display set is provided at a beginning of the display set in a state of being contained within one packet;

10 the time information includes a decoding time stamp and a presentation time stamp which are written in the packet; and

the decoding time stamp shows the decoding start time, and the presentation time stamp shows the display start time.

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4. The recording medium of Claim 1, wherein:

the graphics data in the display set is made up of a sequence of pieces of graphics data a last one of which is immediately followed by an end code; and

20 a time stamp associated with the end code shows a transfer completion time of the last piece of graphics data.

5. The recording medium of Claim 4, wherein:

25 the sequence of pieces of graphics data includes a

piece of referenced graphics data which is referenced by the control segment in the display set and a piece of non-referenced graphics data which is not referenced by the control segment in the display set;

5           the piece of referenced graphics data and the piece of non-referenced graphics data are arranged in the display set in the stated order;

          the sequence of pieces of graphics data is to be sequentially decoded in the order of the arrangement; and

10           the end code immediately follows the last piece of graphics data.

6. The recording medium of Claim 1, wherein:

          the display set further includes window information  
15   that specifies a position, a height, and a width of a window on a screen, the window being a rendering area in which the graphics display is to be composited based on the control segment in the display set before being overlaid on a moving picture represented by the video stream; and

20           a time period from an end of the active period of the control segment in the immediately preceding display set to an end of the active period of the control segment in the display set is equal to a time period required for writing into the entire rendering area.

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7. The recording medium of Claim 1,

wherein the active period of the control segment in the display set overlaps with the active period of the control segment in the immediately preceding display set if the display set and the immediately preceding display set belong to a same unit of memory management in the graphics stream; and

if the display set and the immediately preceding display set belong to different units of memory management in the graphics stream, the time information designates the active period of the control segment in the display set to start at or after an end of the active period of the control segment in the immediately preceding display set.

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8. The recording medium of Claim 1, wherein:

the graphics stream is a presentation graphics stream which is intended to synchronize with a moving picture represented by the video stream or an interactive graphics stream which is intended to produce an interactive display;

the active period of the control segment in the display set overlaps with the active period of the control segment in the immediately preceding display set if the graphics stream is the presentation graphics stream; and

if the graphics stream is the interactive graphics

stream, the time information designates the active period of the control segment in the display set to start at or after an end of the active period of the control segment in the immediately preceding display set.

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9. A reproduction apparatus for reproducing a digital stream generated by multiplexing a video stream and a graphics stream, comprising:

a video decoder operable to decode the video stream  
10 to generate a moving picture; and

a graphics decoder operable to decode the graphics stream to generate graphics, and overlay the graphics and the moving picture, wherein:

- the graphics stream includes a plurality of display  
15 sets each of which is used for a graphics display, the display set including a control segment and graphics data; and

the graphics decoder performs pipeline processing, by starting processing the display set at or after a time  
20 at which, during an active period of a control segment in an immediately preceding display set, transfer of graphics generated by decoding graphics data in the immediately preceding display set to a buffer is completed.

25 10. The reproduction apparatus of Claim 9, wherein:

the buffer is an object buffer for storing graphics generated by decoding;

the graphics decoder includes:

a processor operable to decode the graphics data in  
5 the display set to generate graphics, and transfer the graphics to the object buffer; and

a controller operable to read graphics from the object buffer based on the control segment in the display set, and overlay the read graphics and the moving picture; and

10 in the pipeline processing, the processor transfers the graphics generated by decoding the graphics data in the display set to the object buffer, whilst simultaneously the controller reads graphics from the object buffer based on the control segment in the immediately preceding display  
15 set.

11. The reproduction apparatus of Claim 10, wherein:

the control segment in the display set is provided at a beginning of the display set; and

20 the controller decodes the control segment, and, in accordance with a decoding result of the control segment, reads the graphics from the object buffer and displays the read graphics.

25 12. The reproduction apparatus of Claim 11, wherein:

the control segment in the display set is contained within one packet; and

the controller starts decoding the control segment at a time shown by a decoding time stamp written in the packet, and starts displaying the graphics at a time shown  
5 by a presentation time stamp written in the packet.

13. The reproduction apparatus of Claim 10, wherein:

the graphics data in the display set is made up of  
10 a sequence of pieces of graphics data a last one of which is immediately followed by an end code; and

a time stamp associated with the end code shows a transfer completion time of the last piece of graphics data.

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14. The reproduction apparatus of Claim 13, wherein:

the sequence of pieces of graphics data includes a piece of referenced graphics data which is referenced by the control segment in the display set and a piece of  
20 non-referenced graphics data which is not referenced by the control segment in the display set;

the piece of referenced graphics data and the piece of non-referenced graphics data are arranged in the display set in the stated order; and

25 the processor sequentially decodes the sequence of

pieces of graphics data in the order of the arrangement and transfers graphics generated by the decoding to the object buffer.

5 15. The reproduction apparatus of Claim 14, wherein:

the display set further includes window information that specifies a position, a height, and a width of a window on a screen, the window being a rendering area in which the graphics display is to be composited based on the control  
10 segment in the display set before being overlaid on the moving picture;

the controller displays the graphics display composited based on the control segment in the display set, a predetermined time period after displaying a  
15 graphics display composited based on the control segment in the immediately preceding display set; and

the predetermined time period is equal to a time period required for writing into the entire rendering area.

20 16. The reproduction apparatus of Claim 9, wherein:

the graphics decoder performs the pipeline processing if the display set and the immediately preceding display set belong to a same unit of memory management in the graphics stream; and

25 if the display set and the immediately preceding



display set belong to different units of memory management  
in the graphics stream, the graphics decoder starts  
processing the display set at or after a time at which  
display of the graphics display composited based on the  
5 control segment in the immediately preceding display set  
is started.

17. The reproduction apparatus of Claim 9, wherein:

the graphics stream is a presentation graphics stream  
10 which is intended to synchronize with the moving picture  
or an interactive graphics stream which is intended to  
produce an interactive display;

the graphics decoder performs the pipeline  
processing if the graphics stream is the presentation  
15 graphics stream; and

if the graphics stream is the interactive graphics  
stream, the graphics decoder does not perform the pipeline  
processing.

20 18. A method of recording onto a recording medium,  
comprising the steps of:

generating application data; and

recording the application data to the recording  
medium, wherein:

25 the application data includes a digital stream

generated by multiplexing a video stream and a graphics stream;

the graphics stream includes a plurality of display sets each of which is used for a graphics display;

5 the display set includes a control segment and graphics data, the control segment including time information that designates an active period of the control segment in the display set on a reproduction time axis of the video stream; and

10 when the active period of the control segment in the display set overlaps with an active period of a control segment in an immediately preceding display set, the time information designates the active period of the control segment in the display set to start at or after a time  
15 at which, during the active period of the control segment in the immediately preceding display set, transfer of graphics generated by decoding graphics data in the immediately preceding display set is completed.

20 19. A computer-readable program used for enabling a computer to reproduce a digital stream generated by multiplexing a video stream and a graphics stream, the program enabling the computer to perform the steps of:

decoding the video stream to generate a moving  
25 picture; and

decoding the graphics stream to generate graphics,  
and overlaying the graphics and the moving picture,  
wherein:

the graphics stream includes a plurality of display  
5 sets each of which is used for a graphics display, the  
display set including a control segment and graphics data;  
and

the step of decoding the graphics stream perform  
pipeline processing, by starting processing the display  
10 set at or after a time at which, during an active period  
of a control segment in an immediately preceding display  
set, transfer of graphics generated by decoding graphics  
data in the immediately preceding display set to a buffer  
is completed.

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20. A method of reproducing a digital stream generated  
by multiplexing a video stream and a graphics stream,  
comprising the steps of:

decoding the video stream to generate a moving  
20 picture; and

decoding the graphics stream to generate graphics,  
and overlaying the graphics and the moving picture,  
wherein:

the graphics stream includes a plurality of display  
25 sets each of which is used for a graphics display, the

display set including a control segment and graphics data;  
and

the step of decoding the graphics stream performs  
pipeline processing, by starting processing the display  
5 set at or after a time at which, during an active period  
of a control segment in an immediately preceding display  
set, transfer of graphics generated by decoding graphics  
data in the immediately preceding display set to a buffer  
is completed.

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